

VIRGINIA DEPARTMENT OF TRANSPORTATION

## LOCATION AND DESIGN DIVISION

### INSTRUCTIONAL AND INFORMATIONAL MEMORANDUM

GENERAL SUBJECT: ROADWAY SAFETY FEATURES	NUMBER: IIM-LD-222.11 TE-358.6
SPECIFIC SUBJECT:  NCHRP 350 TEST REQUIREMENTS	DATE:  AUGUST 23, 2011
	SUPERSEDES: IIM-LD-222.10 TE-358.5
LOCATION AND DESIGN DIVISION APPROVAL: Mohammad Mirshahi, P.E. State Location and Design Engineer Approved August 23, 2011	TRAFFIC ENGINEERING DIVISION APPROVAL: Raymond J. Khoury, P.E. State Traffic Engineer Approved August 23, 2011

Changes are shaded.

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#### CURRENT REVISION

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- To add clarity, the Approved Products List attached to this memorandum has been revised to separate Type I Re-Directive Crash Cushions from Type II Non Re-Directive Crash Cushions.
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#### EFFECTIVE DATE

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- This memorandum is effective upon receipt.
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#### BACKGROUND

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- The National Cooperative Highway Research Program (NCHRP) published "Recommended Procedures for the Safety Performance Evaluation of Highway Features" in NCHRP Report 350. As a result of that report, the FHWA issued a requirement that all permanent safety hardware systems included in Federal Aid projects after August 1998 meet NCHRP 350.

- VDOT also extended that requirement to state funded projects. A July 25, 1997 memo from FHWA provided additional requirements regarding dates and conditions of compliance. The compliance date (with some exceptions) was extended to October 1, 1998. This memo also divided work zone devices into four categories with explicit requirements for each of the categories, which we will parallel in this document.
- Subsequent to the July 25, 1997 memo, the following have been made available:
  - July 1, 1998 AASHTO-FHWA Agreement
  - August 28, 1998 memo from the Director, Office of Engineering FHWA, "Crash Tested Work Zone Traffic Control Devices"

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## LONGITUDINAL BARRIER

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- Standard GR-8 (Weak Post) Guardrail has been revised to meet NCHRP 350 testing criteria for high speed roadways. When installations of GR-8 Guardrail have been damaged and need repair/replacement, the guardrail should be "upgraded" to the new Std. GR-8.
- Standard GR-2 (Strong Post) Guardrail using a steel post, and blockouts made of wood or composite, have met NCHRP 350 criteria.

Any existing strong post guardrail installations not in accordance with NCHRP 350 criteria should not be repaired or replaced in kind but upgraded to meet NCHRP 350 when damaged or within the limits of a construction project. When damaged, the extent of damage should govern repair/replacement. If the total run of guardrail is 60 meters (200 feet)±, the entire run shall be replaced with strong post (St'd. GR-2) guardrail. For sections of guardrail that are longer than 60 meters (200 feet), if more than 60% of the entire run has been damaged, the entire run shall be replaced with strong post (St'd. GR-2) guardrail. If less than 60% of the entire run has been damaged, the damaged section should be replaced with strong post (St'd. GR-2) guardrail. Standard GR-3 (Cable) Guardrail met NCHRP 350 criteria.

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## NEW PAY ITEMS

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<u>ITEM CODE</u>	<u>DESCRIPTION</u>	<u>ITEM UNIT</u>
13290	Guardrail GR-8 (NCHRP 350 TL-3)	Linear Feet/Meters
13292	Guardrail GR-8A (NCHRP 350 TL-3)	Linear Feet/Meters
13294	Guardrail GR-8B (NCHRP 350 TL-3)	Linear Feet/Meters
13291	Radial Guardrail GR-8 (NCHRP 350 TL-3)	Linear Feet/Meters
13293	Radial Guardrail GR-8A (NCHRP 350 TL-3)	Linear Feet/Meters
13295	Radial Guardrail GR-8B (NCHRP 350 TL-3)	Linear Feet/Meters
13298	Radial Guardrail GR-8C (NCHRP 350 TL-3)	Linear Feet/Meters
13440	Median Barrier MB-5 (NCHRP 350 TL-3)	Linear Feet/Meters
13441	Median Barrier MB-5A (NCHRP 350 TL-3)	Linear Feet/Meters
13442	Median Barrier MB-5B (NCHRP 350 TL-3)	Linear Feet/Meters

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## GUARDRAIL TERMINALS

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- The MELT (Modified Eccentric Loaded Terminal - Standard GR-7) as it appears in the original 1996 Road and Bridge Standards has not passed NCHRP 350 test requirements to the satisfaction of the FHWA and is therefore not allowed for use after October 1, 1998. The new GR-7 with a revision date of 7/02 specifies designs that meet NCHRP 350 which include proprietary products such as the SRT350 and FLEAT350. These products have been approved by the FHWA for use as flared end terminals. If future testing produces additional options, VDOT's Road and Bridge Standards will be revised appropriately.
- Standard GR-6 Terminal Treatments for W Beam Guardrail is designed to be buried in the cut slope. This terminal design has been revised to meet the NCHRP 350 approved design recommended by FHWA and is furnished as an insertable sheet dated 7/02.
- Standard GR-9 Alternate to the Flared End Terminal is a parallel terminal design that is used for situations in which the flared terminal (Standard GR-7) cannot be installed due to site restrictions. VDOT's Road and Bridge Standards detail specifies that only products approved in accordance with NCHRP 350 test criteria (such as ET-2000, SKT-350, or BEST 350) are acceptable for use as Standard GR-9.

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## IMPACT ATTENUATORS / CRASH CUSHIONS

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- All designs used for permanent installations of impact attenuators/crash cushions must have an FHWA approval letter specifying compliance with NCHRP 350 test requirements and approval by a Professional Engineer in the Location & Design Standards/Special Design Section prior to installation.
- The following alternative crash cushion has been added:
  - TL-2 SCI-70GM, Re-directive Crash Cushion from SCI Products, Inc.
  - TL-3 SCI-100GM, Re-directive Crash Cushion from SCI Products, Inc.

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## CONCRETE BARRIER

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- Concrete Median Barrier meets NCHRP 350; however, testing has proven that impacts with "F" shape barrier resulted in better vehicle stability than with the "New Jersey" shape, especially for smaller vehicles, due to a reduction in the height of the break between the upper and lower slopes. Therefore, VDOT has required the "F" shape concrete median barrier since the January 2000 advertisement. The Department allowed a transition period before requiring the new "F" shape.



- From the January 1996 advertisement until January 2000, contractors were allowed the option of providing either of two types of concrete barrier, as noted below:
  - "New Jersey" shape or "F" shape \*
- \* Note: "F"-Shape barrier was required on selected projects that required more than 2300 meters (7500 ft.) of barrier or other selected projects when required in contract documents.

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## BREAKAWAY OR YIELDING SUPPORTS FOR SIGNS AND LUMINAIRES

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- Includes items such as wood posts, slip bases, breakaway couplers, frangible bases, etc.
- The Department uses devices that currently conform to AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals. The requirements of AASHTO are more stringent than those contained in NCHRP 350 and therefore existing devices are considered to be acceptable.

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## WORK ZONE DEVICES

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- CATEGORY I DEVICES
  - Includes items such as drums, cones, tubular markers, self-erecting delineator posts without any auxiliary device mounted on them except for Type A or C warning lights on drums and ballast located at the base of the devices.

These devices are small and lightweight channelizing and delineating devices that carry virtually no potential to penetrate windshields, cause tire damage or have a significant impact on the control or trajectory of an impacting vehicle. These devices will, however, require certification by the manufacturer that their device is crashworthy – that it meets the evaluation criteria of NCHRP 350 Test Level 3. However, if the contractor has devices in his inventory that he believes meet Category I, but is having problems obtaining a letter of self-certification for them from the manufacturer, he can self-certify his current inventory of Category I devices as meeting NCHRP Report 350 standards if he is willing to be responsible for the crashworthiness of the devices. This certification may be a one-page affidavit signed by the manufacturer or contractor (Information on what should be contained in the self-certification Letter can be accessed at:

[http://safety.fhwa.dot.gov/roadway\\_dept/road\\_hardware/ganda.htm#212](http://safety.fhwa.dot.gov/roadway_dept/road_hardware/ganda.htm#212))

When Type A or C warning lights are used on drums, the certification letter shall indicate that the drum and warning light combination is crashworthy.

- **CATEGORY II DEVICES**

- Includes Category I devices (drums, cones, etc.) with an auxiliary device (warning light except a Type A or C warning light on drums, sign, etc.) mounted on it, portable vertical panel assemblies, portable sign supports, intrusion detectors and alarms, and Type I, II and III Barricades.
- These devices are not expected to produce significant vehicular velocity change, but may otherwise be hazardous by penetrating a windshield, injuring a worker or causing vehicle instability when driven over. The Department has developed an approved list of those devices that comply with NCHRP 350 Test Level 3 and our specifications, and will maintain it on VDOT's web site. When a device is intended to be used that does not appear on the list, a copy of the FHWA acceptance letter for complying with NCHRP 350 will be required from the manufacturer prior to utilizing that device. On construction/maintenance projects the Contractor will be required to furnish a certification letter indicating those devices he intends to use are on the approved list or FHWA acceptance letters for devices not existing on the Department's approved list.
- Category I devices with an auxiliary device attached (except drums with a Type A or C warning light)

These devices shall have been tested with the type of auxiliary device attached for conformance with NCHRP 350, Test Level 3, and an acceptance letter issued by FHWA.

- **Portable Vertical Panel Assemblies**

Portable Vertical Panel Assemblies shall have been tested for conformance with NCHRP 350, Test Level 3, and an acceptance letter issued by the FHWA. Portable vertical panel assemblies with an auxiliary device mounted on it shall not be used unless they have been tested and approved under NCHRP 350, Test Level 3.

- **Portable Sign Supports**

- **Tripod Type**

Tripod portable sign supports shall not be used.

- **Self-erecting Type**

Self-erecting portable sign supports shall have been tested with the type of sign that is intended to be used with it for conformance to NCHRP 350, Test Level 3 and an acceptance letter issued by the FHWA. Other sign materials are allowed for use on the Portable Sign Supports when approved by the FHWA and indicated in an FHWA acceptance letter.

- Intrusion Detectors and Alarms

These devices shall have been tested for conformance to NCHRP 350, Test Level 3 and an acceptance letter issued by the FHWA. Even though these devices are not normally required on projects, the Contractor will be required to furnish a copy of the FHWA acceptance letter if they plan to use such a device.

- Type I and II Barricades

These devices are not used by the Department and therefore will not affect our operations.

- Type III Barricades

These devices shall be in conformance with NCHRP 350, Test Level 3, with an acceptance letter issued by the FHWA. Please note that VDOT's Road and Bridge Standards BD-1 and BP-2 shall no longer be used.

- CATEGORY III DEVICES

- Includes items such as barriers, crash cushions, fixed sign supports, and truck mounted attenuators.

- These devices can cause significant velocity changes or other potentially harmful reactions to impacting vehicles.

- Concrete Traffic Barrier Service

For **temporary** locations, only "F" shape Concrete Traffic Barrier Service shall be used. When used in conjunction with a temporary installation, a positive connection (joint that transfers tension and moment from one segment to another) will be required. Beginning with the January 2000 advertisement, all positive connections must be approved in accordance with NCHRP 350.

When Temporary Concrete Traffic Barrier Service is being used on any VDOT project, the barrier deflection must be taken into account when planning work zones. The deflection area must remain free of hazards such as steep fill slopes, construction equipment, personnel, etc.

- Temporary Attenuators/Crash Cushions

These devices shall have been tested for conformance to NCHRP 350 and an acceptance letter issued by the FHWA. This is effective for devices used by the Department and for construction/maintenance projects beginning with January, 1999 advertisements.



## Fixed Sign Supports

The Department uses wood posts and other supports, which are listed in the Department's Special Products Evaluation List (SPEL), for fixed sign supports. These devices currently conform to AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals. The requirements of AASHTO are more stringent than those contained in NCHRP 350 and therefore existing devices are considered to be acceptable.

- Truck Mounted Attenuators

Truck mounted attenuators purchased after October 1, 1998 shall have been tested for conformance to NCHRP 350 and an acceptance letter issued by the FHWA. Truck mounted attenuators used on all Limited Access Highways, and four or more lane Primary Highways with speed limits 55 mph or greater, shall conform to NCHRP 350, Test Level 3.

- CATEGORY IV DEVICES

- Includes portable items, usually trailer-mounted devices such as area lighting supports, arrow boards, portable traffic control signals, and portable changeable message signs.
- The FHWA has monitored studies of Category IV Devices since 1993. Studies show there is very little evidence that these devices are being struck frequently enough, nor are they causing injury severities that warrant either shielding with a barrier, or complete redesign of the trailers to make them crashworthy. A crash test matrix for Category IV Devices is being included in the procedures that will replace Report 350. Manufacturers who wish to build and test a crashworthy device will use these test procedures. Although the FHWA encourages the industry to develop safer trailers, crash testing of Category IV Devices will not be required by the FHWA in the foreseeable future. Proper placement of arrow panels and changeable message signs can help reduce the potential for crashes. Guidelines for placing and delineating these work zone trailers may be found in the MUTCD, Sections 6F-52 and 6F-53, the Virginia Work Area Protection Manual, Sections 6F.55 and 6F.56, and AASHTO's Roadside Design Guide, Chapter 9, Section 9.4.2.4 and in FHWA Acceptance Letter WZ-45.

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## VDOT APPROVED PRODUCTS

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- VDOT's Approved Products List is available at:  
<http://www.virginiadot.org/business/locdes/nchrp350-index.asp>
- For information regarding VDOT's NCHRP 350 Approved Products List, please contact Charles W. Patterson, P.E., Standards and Special Design Section Manager at [Chuck.Patterson@VDOT.Virginia.gov](mailto:Chuck.Patterson@VDOT.Virginia.gov) or (804) 786-1805.